Industrial Technologies Program

Olefins by High-Intensity Oxidation

New, High-Intensity Oxidation Reactors Promise Significant Energy Savings for Ethylene Production

Ethylene is a vital intermediate for the U.S. petrochemical industry. Virtually everything touched, worn, or eaten by U.S. consumers contains, is packaged in, or requires inputs of ethylene and/or its derivatives. In 2000, about 60 billion pounds of ethylene were produced in the U.S. alone, representing more than 27 percent of the global production of 220 billion pounds. Conventional ethylene production is most often carried out through energy intensive hydrocarbon steam cracking, which involves heating hydrocarbon feedstocks and steam at nearly atmospheric pressures in metal furnace tubes.

Researchers at Velocys Inc., The Dow Chemical Company, and Pacific Northwest National Laboratory are collaborating in an effort to improve the ethylene production process via the production of olefins by high-intensity oxidation in highly heat-integrated microchannels. The process has the potential to improve feedstock utilization and obtain substantial energy savings through the ability to control reaction temperatures. The project is focused on microscale energy and mass transfer management, and is designed to alleviate transport limitations and thereby improve catalyst selectivity and save energy-rich feedstocks. Potential energy savings for this microprocess technology can be as high as 150 trillion Btu by 2020.

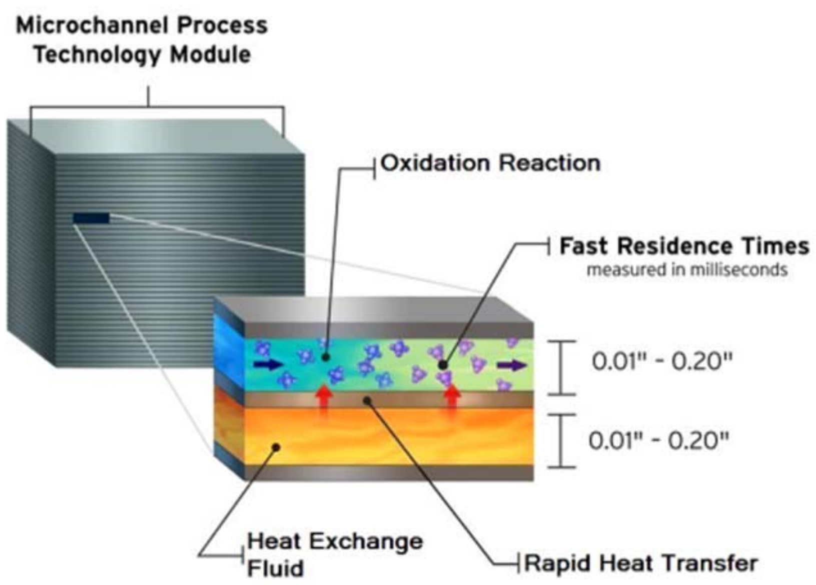

Fig. 1: Microchannel technology permits close integration of exothermic and endothermic reactions to achieve high efficiency in a compact reactor.

Benefits

By 2020:

- *Potential energy savings of 150 trillion Btu per year*
- *Potential reduction in capital and operating costs of $400 million*
- *Reduced NOx emissions by 8 million lbs/year*

Applications

The high-intensity oxidation reactor process under investigation is exclusively for the production of ethylene. However, the subsequent advances in microchannel process technology that result from this, could be applied to a wide range of chemical production processes.

Project Partners

- *Velocys, Inc.*
- *Dow Chemical Company*
- *Pacific Northwest National Laboratory*

Project Description

Goal: The overall goal of the project is to develop a commercially viable high-intensity process to produce ethylene by controlled oxidative dehydrogenation of hydrocarbons (mainly ethane) in a microchannel reactor.

Activities: To meet their goal, project partners have developed a series of specific objectives and activities.

- Adapt computational reactor models to design the geometry and evaluate the performance of a microchannel reactor with improved selectivity and/or productivity in the catalytic oxydehydrogenation of ethane to ethylene.
- Design, build and test single- and multi-channel reactors for ethane oxydehydrogenation
- Demonstrate, at the laboratory scale, the improved catalytic performance needed to achieve economic advantage and energy savings
- Develop integrated process flowsheets including conversion, separation, recovery, and utilities that optimize the advantages of the process
- Determine the most effective means to retrofit existing ethylene plants
- Calculate the capital and operating costs of the high-intensity microprocess technology ethylene process and compare to conventional processes

Progress and Milestones

The technical project milestones for this 36 month effort are summarized below:

- Demonstrate catalyst adaptation (month 6)
- Complete operation of single-channel reactor and economic projections (month 14)
- Complete catalyst optimization (month 28)
- Complete operation of multi-channel reactor (month 36)
- Complete comparative economics (month 36)

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